"Constant-Standard Silver Trial-Plates." By EDWARD MATTHEY, C.B., F.S.A., F.C.S., Assoc. Roy. Sch. Mines. Communicated by Sir WILLIAM CROOKES, F.R.S. Received January 11,—Read February 11, 1904.

Referring to my paper communicated to the Royal Society, February 16, 1894, and read March 15, 1894,* in which it was shown that moderately sized plates of sterling silver of a uniform standard could be obtained by casting from thin castings, my attention since then was drawn to the difficulty of casting larger quantities than those described in that paper, which were only of an average weight of 4 to 5 kilogrammes per plate, and to the desirability of obtaining a large plate, say of some 8 or 10 kilogrammes in weight, without difficulty, and I have therefore resumed my attention towards effecting this. It appears that considerable difficulties have been experienced with regard to obtaining large plates of constant standard.

In the Royal Mint Report of 1873 is a memorandum appended by Professor W. Chandler Roberts, which refers to a series of well-known experiments with regard to obtaining a constant alloy of 0·900 silver by Levol in the Paris Mint, he himself being at the time engaged in the preparation of a standard silver trial-plate. Professor Chandler Roberts states:—"From the foregoing remarks it will be evident *that it is impossible to cast a standard silver plate or bar of uniform composition*, and it was necessary therefore to resort to an artifice in order to obtain a standard trial-plate of the required dimensions."†

The means adopted by him were to cast 1000 ozs. of standard silver into a skillet-mould 30 cm. long, 25 cm. wide and 5 cm. broad, to plane off 4 mm. from its surface and to roll the planed skillet to 1·8 mm. thickness, a sheet being produced 1·5 m. long, 45 cm. wide. From this the portion was cut which showed constant results about 925, but which varied from 924·6—925·1; and the rest of the plate which varied from 924 (lowest) to 928·4 (highest) was abandoned. He shows all these results by diagrams accompanying his memoranda. The portion of available constant standard so cut out from the 1000 oz. sheet weighed 104 oz., about one-tenth of the whole plate. And this 104 oz. (= 3·230 kilogrammes) formed the mint trial plate from a mass of 1000 oz. (= 31·103 kilogrammes) specially cast for the purpose.

Notwithstanding that many experiments were subsequently made by Professor Roberts Austen to find a means of obtaining a constant standard trial-plate, in 1899 he was compelled to resort to what he calls the "cumbrous expedient" of 1873. His statement is:—"None

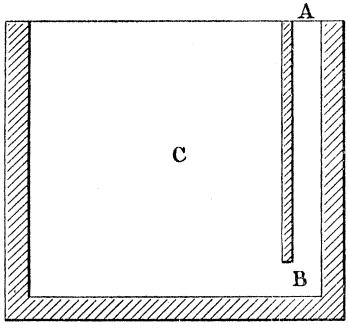
* 'Roy. Soc. Proc.,' vol. 55, 1894, p. 265.

† Fourth Annual Report, Deputy Master of Mint, 1873, pp. 44—46.

of the results were satisfactory, and eventually, after no less than 31 plates had been cast without success, recourse was had to the method adopted in 1873, of casting a large mass of metal and detaching a particular portion which proved by assay to be of approximately uniform standard."*

The casting of the standard silver into thin instead of into the thick moulds ordinarily employed having been attended with such excellent results,† I was induced to believe that it must be due to the more rapid cooling of the metal, by which liquation was arrested; so that if the standard silver were cast into moulds sufficiently cooled, liquation might be induced to disappear altogether. In order then to overcome the difficulty of obtaining the standard trial-plates in larger sizes, I commenced by casting quantities of not less than 8 kilogrammes into a mould cooled externally by ice, and also by freezing mixtures as low as 10° C., and by these means I obtained most encouraging results—results which confirmed me in the supposition that by cooling with rapidity there is less time for liquation, which appears to be the direct converse of what has been supposed hitherto, viz.: "that a uniformity of standard was best attained by slow and uniform cooling."‡ But although I thus obtained exceedingly good results (two of these are subjoined, see p. 126), I was not satisfied that this was the *best* way of producing a constant-standard plate.

I therefore adopted a different method of casting the standard silver. Instead of pouring the melted alloy into a mould from the top, I poured it into a mould by which the skillet was produced from the bottom, thus:—



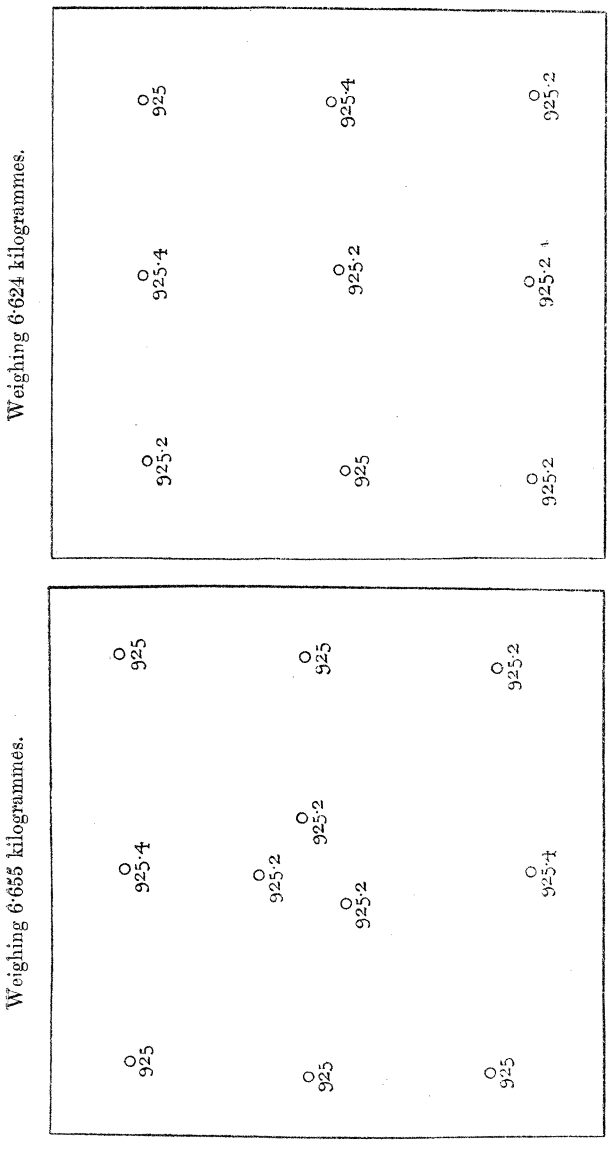
Rough Section of Cast-iron Mould employed.

By pouring the alloy into the gate A the metal passes by B into the space C. And instead of cooling the mould by ice or freezing mixture I used the mould simply cold. I have obtained excellent results by

* Thirtieth Annual Report, Deputy Master of Mint, 1893, pp. 69, 70.

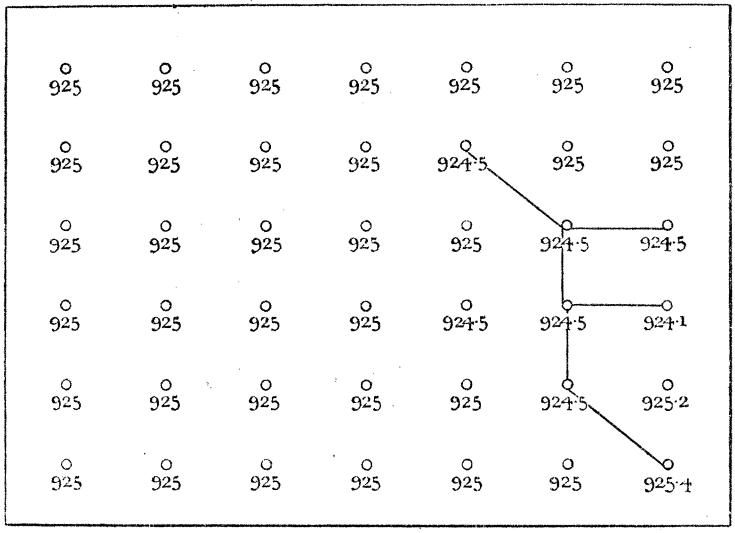
† *Vide* my paper of February 16, 1894, before referred to.

‡ *Vide* memorandum already referred to in Mint Report, 1873.



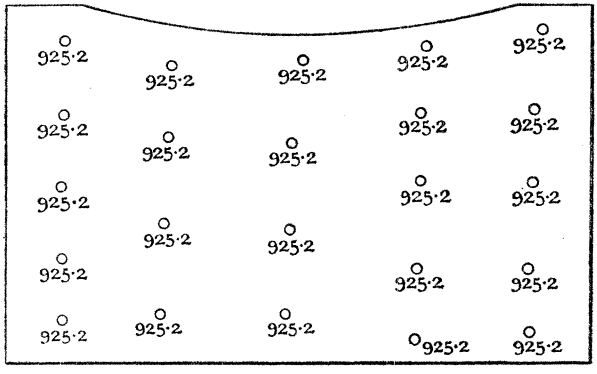
this method. Subjoined is one of the plates produced rolled to 1 mm. thick, measuring 90 cm. × 75 cm. and weighing 8·700 kilogrammes. Trimming the rough edges from the plate about 1 cm., the results came out as under, showing a constancy of 925 nearly all over the plate. I have drawn a line where the only wave of lower variation occurs.

Weighing 7·870 kilogrammes.



75 cm. by 90 cm. and 1 mm. in thickness.

Another cast simply into a cold mould, and rolled to a thickness of 1 mm., gave—



This only weighed 3·640 kilogrammes, is without any wave of variation, and is absolutely constant.

The hitherto accepted theory "that the molecular rearrangement is comparatively slight if the mass of metal is slowly and uniformly solidified"* is contradicted by the results I have obtained; and the results all bear out the fact that there is little or no difficulty in obtaining an 8 or 10-kilogramme plate of constant-standard silver, or even more if necessary.

* Fourth Annual Report, Deputy Master of Mint, 1873, p. 46.